

WHAT IS CLAIMED IS:

- 1           1. A method of reallocating data among physical disks corresponding to a  
2 logical disk, the method comprising:
  - 3                 partitioning a logical disk into a plurality of groups, each group comprising at  
4 least one segment on at least one of a first plurality of physical disks corresponding to the  
5 logical disk;
  - 6                 partitioning one group of the plurality of groups into a plurality of sub-groups;  
7 and  
8                 for each sub-group of the plurality of sub-groups but one, copying the sub-  
9 group to at least one segment on at least one of a second plurality of physical disks  
10 corresponding to the logical disk.
- 1           2. The method of claim 1, further comprising:  
2                 determining a highly accessed group of the plurality of groups; and  
3                 wherein partitioning one group includes partitioning the highly accessed  
4 group.
- 1           3. The method of claim 1, further comprising repeating the partitioning  
2 one group step and repeating the for each sub-group, copying the sub-group step for another  
3 group of the plurality of groups.
- 1           4. The method of claim 1, further comprising indicating the one sub-  
2 group of the plurality of sub-groups as a new group in the plurality of groups.
- 1           5. The method of claim 4, further comprising indicating each sub-group  
2 of the plurality of sub-groups but the one as a new group in the plurality of groups.
- 1           6. The method of claim 1 further comprising, for the one sub-group of the  
2 plurality of subgroups, copying the sub-group to at least one segment on at least one of the  
3 second plurality of physical disks.
- 1           7. The method of claim 1 further comprising:  
2                 receiving a request to read data from one of the sub-groups of the plurality of  
3 sub-groups but the one;  
4                 determining whether the requested sub-group is currently being copied;

5                   if not currently being copied, reading the data from the sub-group on the at  
6 least one of the second plurality of physical disks;  
7                   if currently being copied, reading the data from the group corresponding to the  
8 sub-group on the at least one of the first plurality of physical disks.

1                 8.         The method of claim 1 further comprising:  
2                   receiving a request to write data to one of the sub-groups of the plurality of  
3 sub-groups but the one;

4                   determining whether the requested sub-group is currently being copied by  
5 checking a status of the one of the sub-groups;  
6                   if currently being copied, changing the status of the one of the sub-groups to  
7 indicate that copying of the one of the sub-groups is completed; and  
8                   writing the data to the one of the sub-groups.

1                 9.         The method of claim 8 further comprising, if currently being copied,  
2 writing the data to the group corresponding to the one of the sub-groups on the at least one of  
3 the first plurality of physical disks.

1                 10.      A storage device comprising:  
2                   a first plurality of physical disks corresponding to a logical disk, wherein the  
3 logical disk is partitioned into a plurality of groups, each group comprising at least one  
4 segment on at least one of the first plurality of physical disks;

5                   at least a second physical disk corresponding to the logical disk;  
6                   a processor, coupled with the first plurality of physical disks and with the at  
7 least a second physical disk, the processor configured to:

8                   partition one group of the plurality of groups into a plurality of sub-  
9                   groups; and  
10                  for each sub-group of the plurality of sub-groups but one, copy the  
11                   sub-group to at least one segment on the at least a second physical  
12                   disk; and

13                  a disk controller, coupled with a first memory, with the first plurality of  
14 physical disks and with the at least a second physical disk, and coupled to receive I/O  
15 requests for the logical disk from at least one host computer, the disk controller configured to:

16                   determine one or more of the physical disks of the first plurality of  
17                   physical disks and the at least a second physical disk to which an  
18                   I/O request corresponds; and  
19                   perform the requested I/O to the determined one or more of the  
20                   physical disks.

1                 11. The storage device of claim 10, wherein the processor is further  
2                 configured to:  
3                   determine whether an I/O request to read data corresponds to data  
4                   within a sub-group being copied to the at least a second physical  
5                   disk;  
6                   if not currently being copied, read the data from the sub-group on the  
7                   at least a second physical disk;  
8                   if currently being copied, read the data from the group corresponding  
9                   to the sub-group on the first plurality of disks.

1                 12. The storage device of claim 10, wherein the processor is further  
2                 configured to:  
3                   determine whether an I/O request to write data corresponds to data  
4                   within a sub-group being copied to the at least a second physical  
5                   disk;  
6                   if currently being copied, change a status of the sub-group to indicate  
7                   that copying of the sub-group is completed; and  
8                   write the data to the sub-group on the at least a second physical disk.

1                 13. The storage device of claim 12, wherein the processor is further  
2                 configured to write the data to the group corresponding to the sub-group on the first plurality  
3                 of physical disks.

1                 14. A method of reallocating data among physical disks corresponding to a  
2                 logical disk, the method comprising:  
3                   partitioning a logical disk into a plurality of groups, wherein each group  
4                   comprises a plurality of segments on at least one of a first plurality of physical disks  
5                   corresponding to the logical disk;  
6                   determining a most frequently accessed group of the plurality of groups;

7                   partitioning the most frequently accessed group into a plurality of sub-groups,  
8 including partitioning each segment of the plurality of segments comprising the most  
9 frequently accessed group into a plurality of sub-segments, wherein each sub-group  
10 comprises at least one sub-segment;

11                   for each sub-group of the plurality of sub-groups but one, allocating at least  
12 one segment on at least one of a second plurality of physical disks corresponding to the  
13 logical disk, each segment on the second plurality of disks corresponding to the at least one  
14 sub-segment comprising the sub-group; and

15                   for each sub-group of the plurality of sub-groups but the one, copying the  
16 corresponding at least one sub-segment to the corresponding at least one segment on the at  
17 least one of the second plurality of physical disks.

1                 15.     The method of claim 14 further comprising, for the one sub-group of  
2 the plurality of sub-groups:

3                   allocating at least one segment on at least one of the second plurality of  
4 physical disk, each segment on the second plurality of disks corresponding to the at least one  
5 sub-segment comprising the one sub-group; and

6                   copying the corresponding at least one sub-segment to the corresponding at  
7 least one segment on the at least one of the second plurality of physical disks.

1                 16.     A storage device comprising:

2                   a first plurality of physical disks corresponding to a logical disk, wherein the  
3 logical disk is partitioned into a plurality of groups, each group comprising at least one  
4 segment on at least one of the first plurality of physical disks;

5                   at least a second physical disk corresponding to the logical disk;

6                   a processor, coupled with the first plurality of physical disks and with the at  
7 least a second physical disk, the processor configured to:

8                   partition one group of the plurality of groups into a plurality of sub-  
9 groups; and

10                  for each sub-group of the plurality of sub-groups but one, copy the  
11 sub-group to at least one segment on the at least a second physical  
12 disk.

1               17. The storage system of claim 16, wherein the processor is further  
2 configured to determining a highly accessed group of the plurality of groups, and wherein  
3 partitioning one group includes partitioning the highly accessed group.

1               18. The storage system of claim 16, wherein the processor is further  
2 configured to repeat the partitioning one group step and to repeat the for each sub-group,  
3 copying the sub-group step for another group of the plurality of groups.

1               19. The storage system of claim 16, wherein the processor is further  
2 configured to, for the one sub-group of the plurality of subgroups, copy the sub-group to at  
3 least one segment on at least one of the second plurality of physical disks.

1               20. The storage system of claim 16, wherein the processor is coupled to  
2 receive I/O requests for the logical disk from at least one host computer, and wherein the  
3 processor is further configured to:

4                      determine one or more of the physical disks of the first plurality of  
5                      physical disks and the at least a second physical disk to which an  
6                      I/O request corresponds; and  
7                      perform the requested I/O to the determined one or more of the  
8                      physical disks.